

# Water Resource Analysis of the Pawnee-Buckner-Sawlog Subbasin

Hodgeman, Ness, and Pawnee Counties  
Subbasin Water Resource Management Program



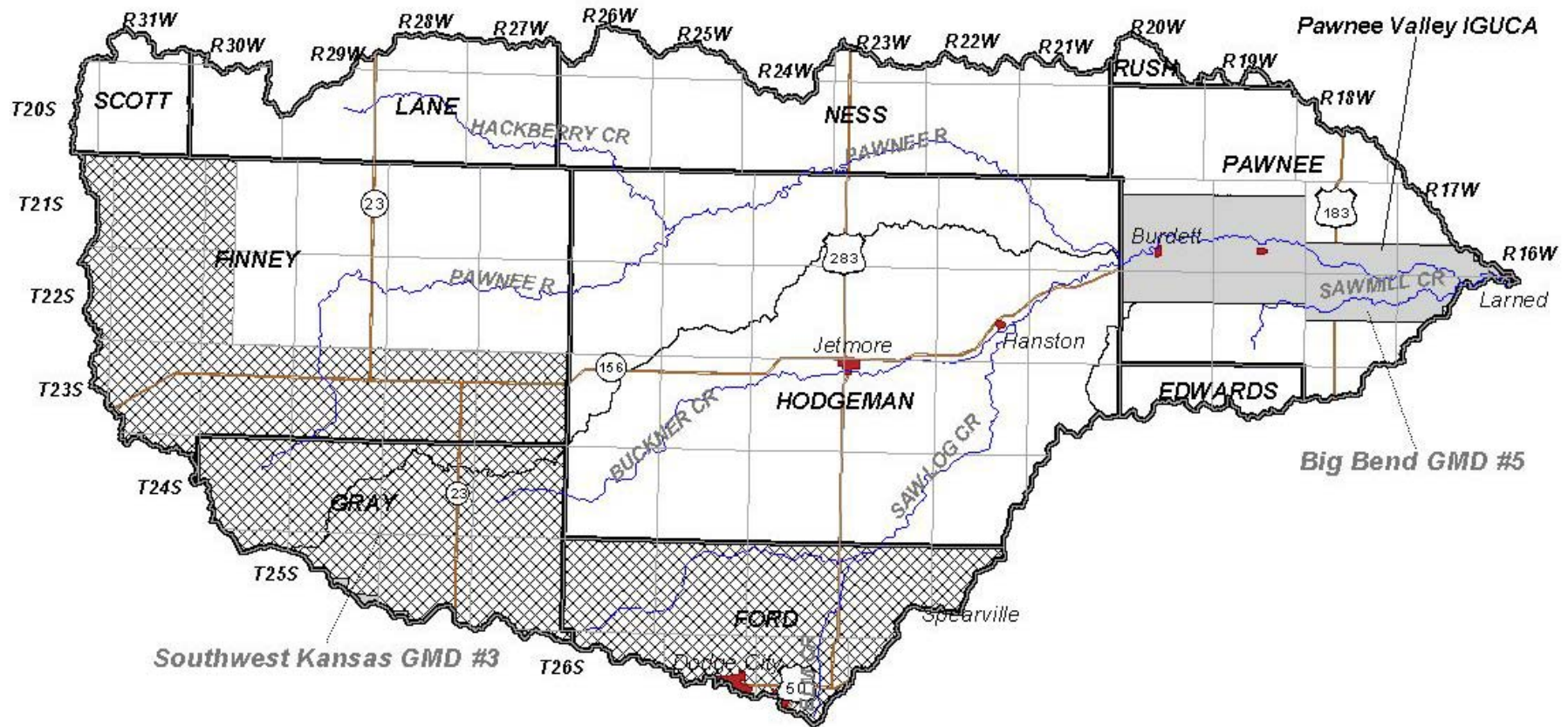
# Introduction

- SWRMP data analysis of water resource management within the part of the Pawnee-Buckner-Sawlog Subbasin in Hodgeman, Ness, and Pawnee Counties.
- Water resources consist of surface and ground water within the alluvial valley of the Pawnee River, Buckner Creek, and Sawlog Creeks, the Ogallala-High Plains aquifer and the Dakota Aquifer.

# Introduction

- SWRMP was initiated in 1993 and was designed to develop comprehensive, long-term management strategies to address ground water declines and surface water depletion in hydrologic subbasin.
- Objective is to use a holistic approach to develop long-term water management strategies in the subbasin.

# Pawnee-Buckner-Sawlog Subbasin



# Pawnee-Buckner-Sawlog Subbasin Project

- Project initiated in 1994
- Kansas Water Plan set a goal to implement a water management policy in the Pawnee River alluvial corridor that addresses the hydrologic differences in the area.
- SWRMP worked with local committee of volunteers to evaluate the hydrologic properties of the alluvial valley.

# Pawnee-Buckner Sawlog Subbasin Project

- The SWRMP staff has held thirteen meetings between the years of June 10, 1996 and February 24, 1999
- The Pawnee-Buckner subbasin committee submitted its proposed management plan to the chief engineer in February 2000.
- The 2000 management was not approved due to some unacceptable management strategies.
- The committee split into two representative groups, one from Pawnee county and the other from Hodgeman and Ness counties.

# Pawnee-Buckner Sawlog Subbasin Project

- Each group submitted a revised management proposal to the chief engineer.
- SWRMP and KDA-DWR worked with the committee to reach a consensus for one management plan and was not able to reach consensus on all issues.
- Consensus was reached to divide the subbasin into 10 hydrologic subunits, implement a drought contingency plan (DCP) which included water use restrictions and establishing drought level points.
- Consensus was not reached on how to establish the drought level point to implement the DCP and the approach for water use restrictions.



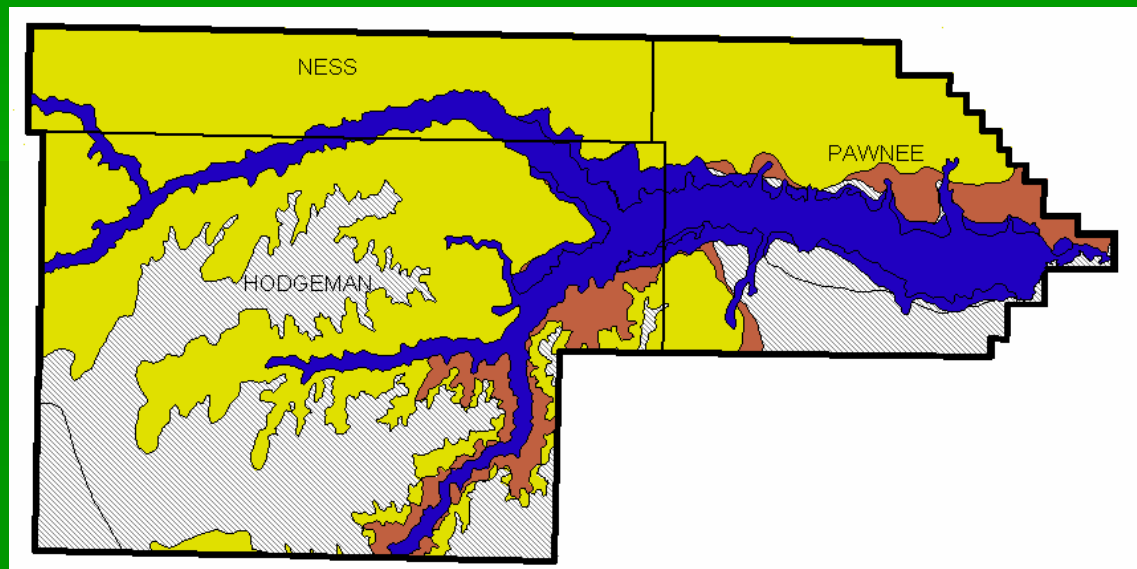
# History of Water Resources in the Subbasin

- 1976, Pawnee county residents voted to be part of the Big Bend Groundwater Management District No.5
- In 1978, the chief engineer declared a moratorium on the approval of applications within the boundaries of the Big Bend GMD No. 5.
- In 1981, the chief engineer issued an interim order designating the Pawnee Valley in Pawnee county as an IGUCA
- In 1985, the chief engineer amended the safe-yield criteria in the Pawnee Valley IGUCA at the request of the Big Bend GMD No. 5 board of directors.
- In 1988, chief engineer approved the SW Kansas GMD No. 3 change to its district boundaries to reflect differences between the Ogallala High aquifer and the Buckner Creek alluvium and exclude Hodgeman county .
- In 1989, the chief engineer placed a moratorium that closed Hodgeman and Ness counties to further appropriations
- October 25, 2002, the chief engineer closed the subbasin to future appropriations.

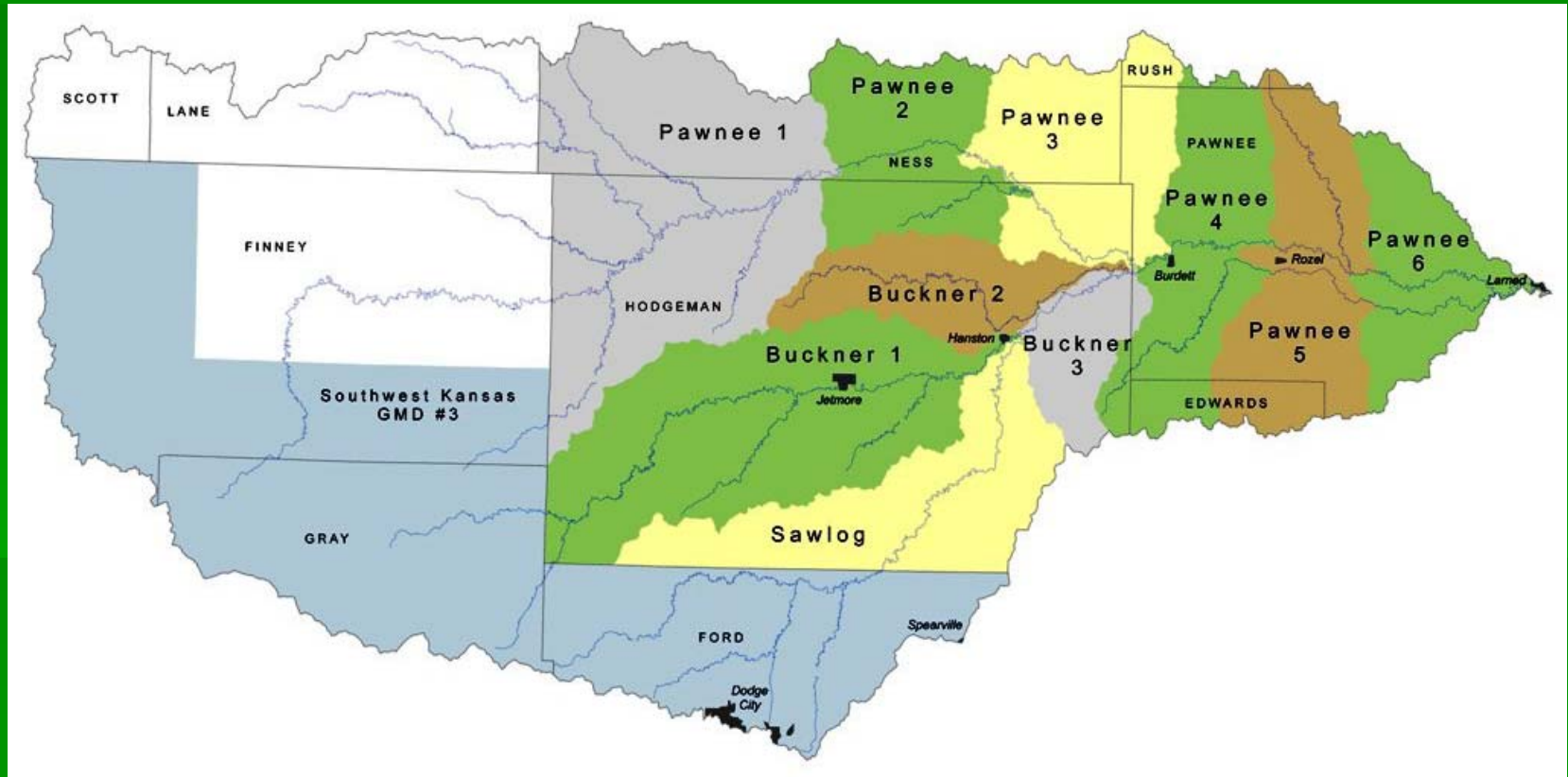


# Hydrogeology

- Three aquifer systems supply ground water and surface water in the subbasin:
  - The Alluvial
  - The Ogallala-High Plains
  - The Dakota



# Pawnee-Buckner-Sawlog Hydrologic Subunits



# Pawnee County

## Committee Recommendations

- Based water use restrictions on the Kansas Irrigation Guide using net irrigation requirements (NIR, 50% chance of rainfall) for Pawnee, Hodgeman, and Ness counties on the highest reported acres in 1996-2000 and priority.
- 40% depletion of water bearing aquifer thickness to set the DLP

# Hodgeman-Ness County Committee Recommendations

- Reduce water rights by percentages for the DCP based on priority to be applied to non-vested water rights when water levels fall below the DLP
- Use a 40% in Pawnee County and 50% reduction in water bearing aquifer thickness in Hodgeman and Ness Counties to establish the DLP
- Prohibit the use of all end guns for all water rights regardless of water right priority

# Additional Committee Recommendations

- Increase rate of diversion to allow maximum efficiency for irrigation and limit the permitted acre-feet.
- Water users participating in the flex accounts program will not be exempt from water use restrictions during the DCP
- Vested and municipal water rights file water conservation plans
- Subject wells screened in the alluvial and Dakota aquifer to the same restrictions as the alluvial aquifer
- Water rights that have over-pumped their allocation during the DCP to be subject to additional reductions
- Allow future appropriations
- Allow continued construction of watershed dams
- Plug Cedar Hills saltwater disposal wells

# Additional Committee Recommendations

- Implement water right purchase program within one mile of Pawnee River
- Exempt wells that are state certified at 400 gpm or less from flow meter requirements (HG-NS) and 200 gpm (PN)
- Conserve water by utilizing center pivots with drop nozzles, subsurface drip, surge valves, watershed dams, terraces and no end guns
  - USGS and KSU reports

# Implementation of Meter Order in Hodgeman and Ness Counties

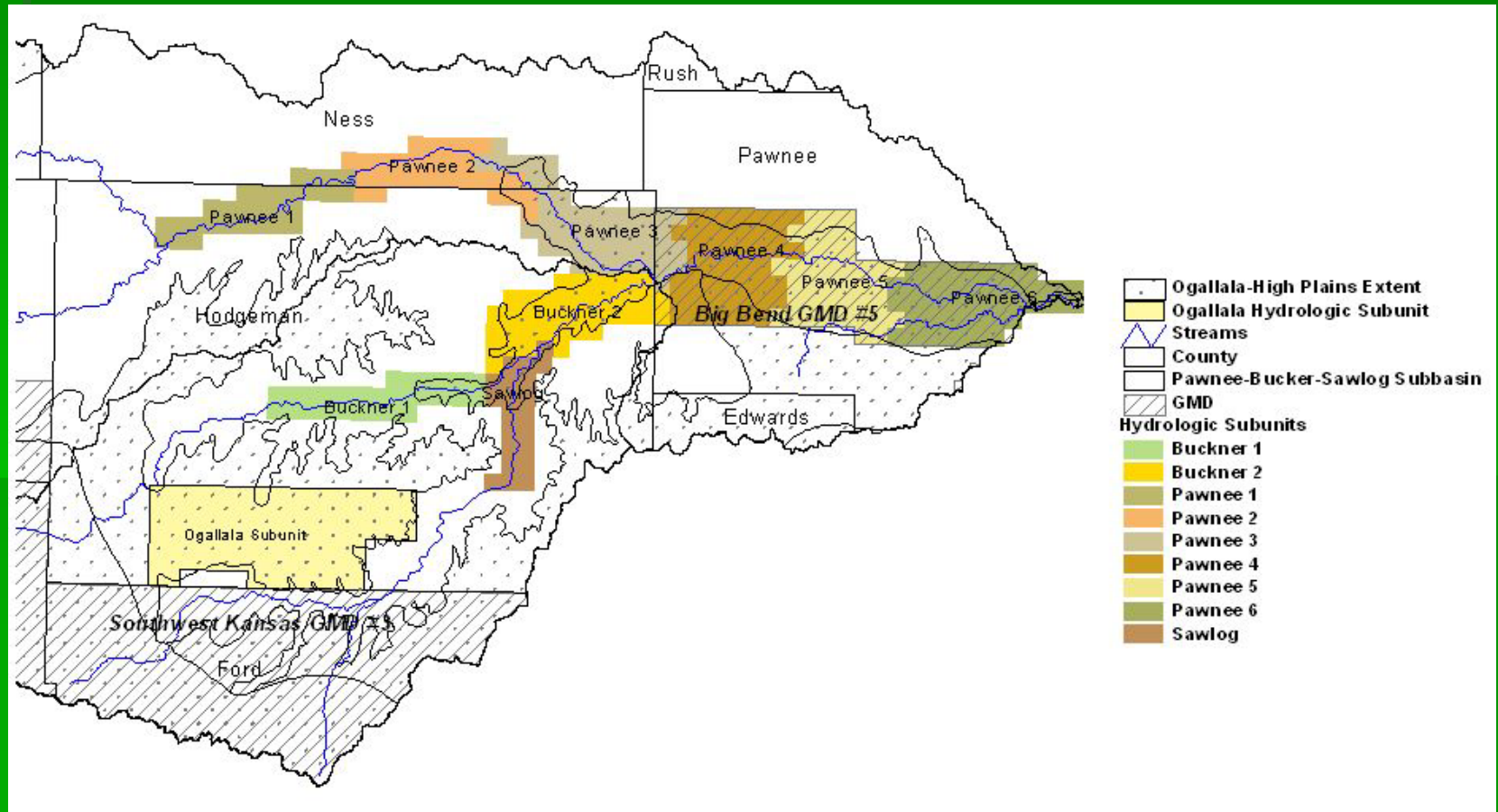
- Sept. 9, 2005 KDA-DWR issued orders for all non-temporary, non-domestic surface and ground water points of diversion in Hodgeman and Ness counties to install flow meters on each authorized point of diversion prior to the following deadlines
- This will allow for accuracy of water use reporting and implementing the DCP



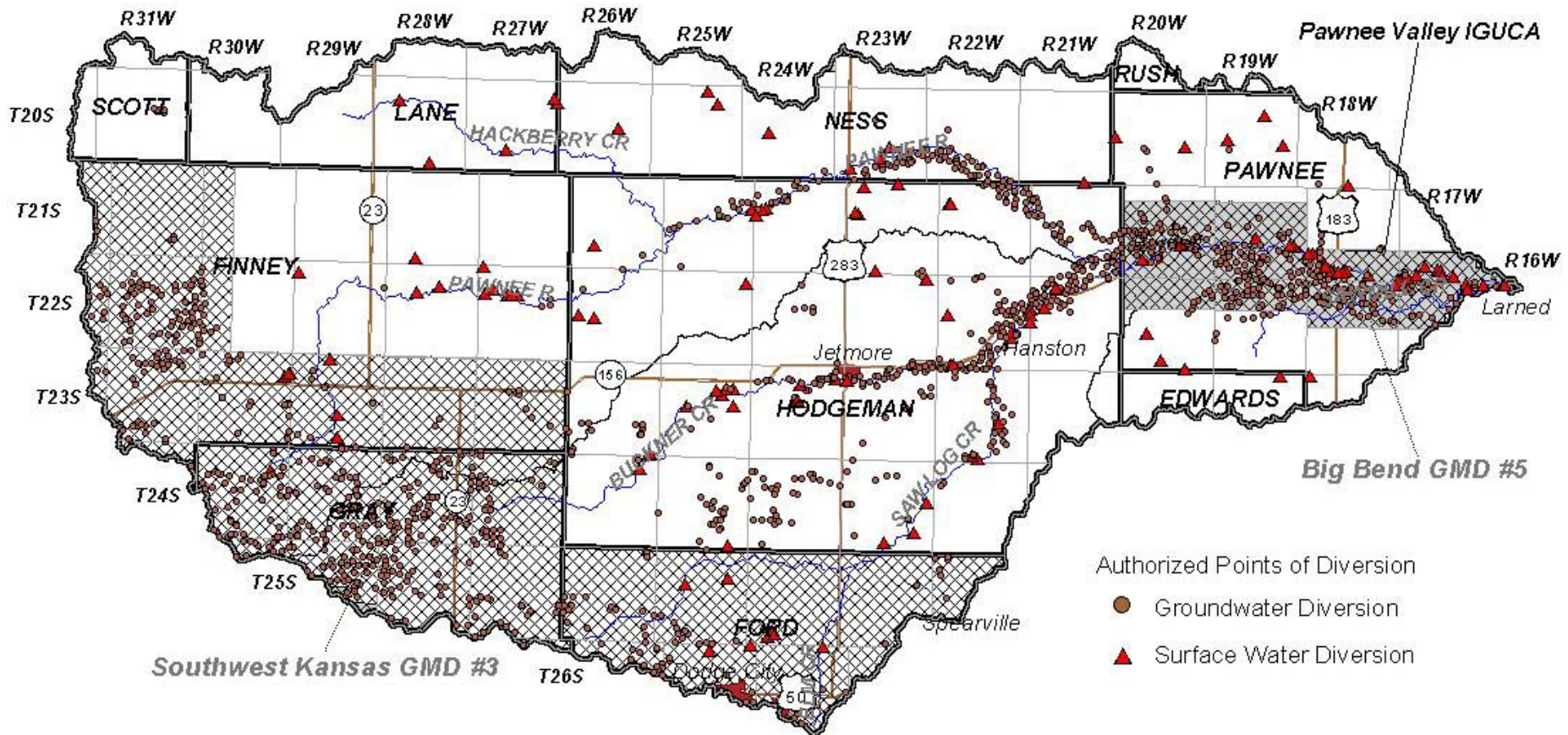
# Hydrologic Subunits

- SWRMP analyzed the hydrologic conditions of the ten subunits and determined that it could be proposed as nine alluvial hydrologic subunits.
  - Combined Buckner 2 & 3 due to similar hydrologic properties
- Areas with little or no alluvial water bearing aquifer thickness, water right development or wells drilled in the confined Dakota are excluded from the nine hydrologic subunits.
- A tenth hydrologic subunit is proposed for the Ogallala-High Plains

# Hydrologic Subunits

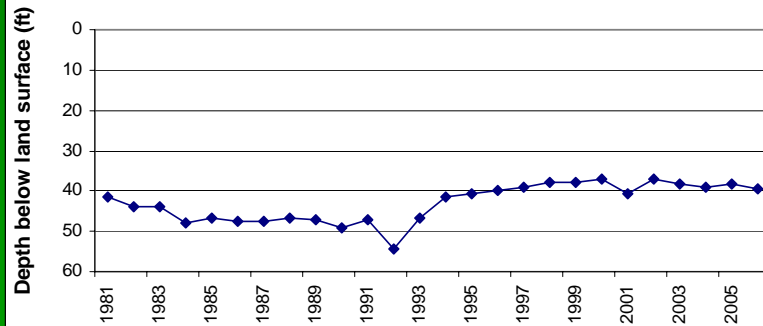


# Ground and Surface Water Right Data Analysis

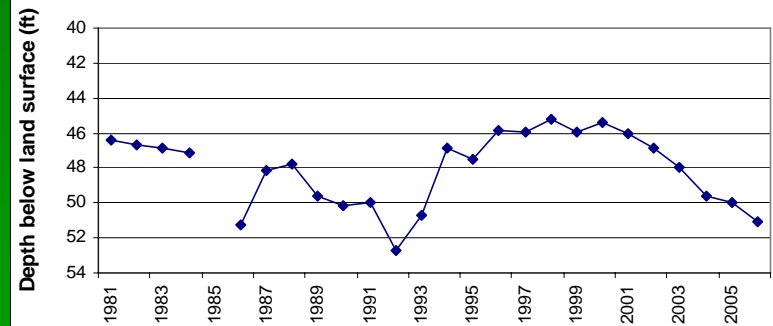


# Ground Water Data Analysis

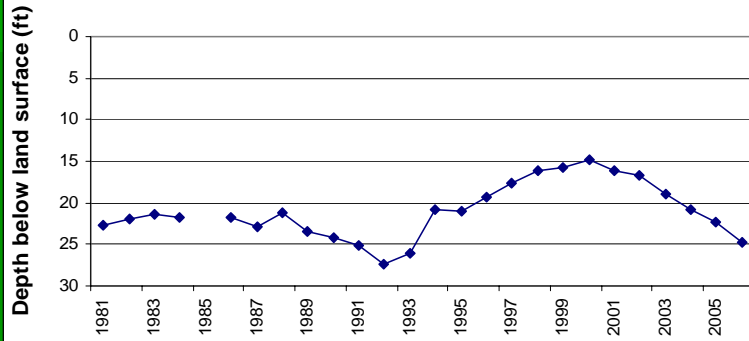
Well NS 7, 20S 22W 20 CCC



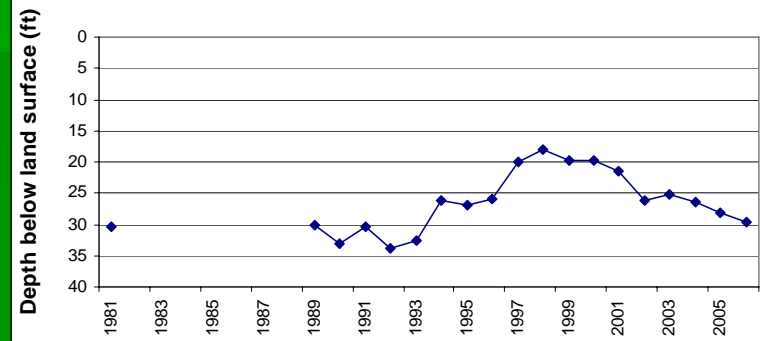
Well HG 32, 21S 21W 36 BCC



Well HG 37, 22S 22W 4 AAA

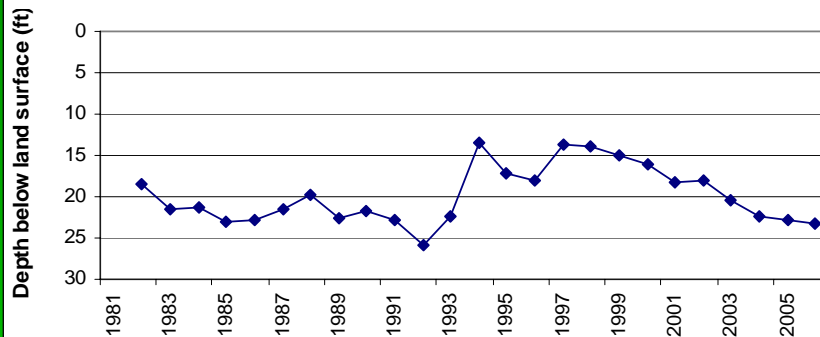


Well HG 9, 23S 22W 11 CCC

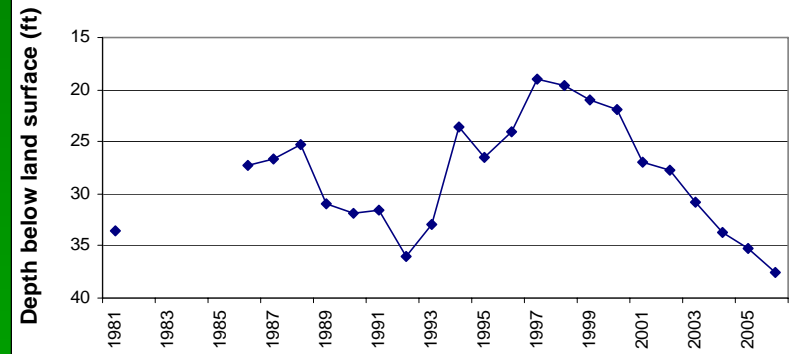


# Ground Water Data Analysis

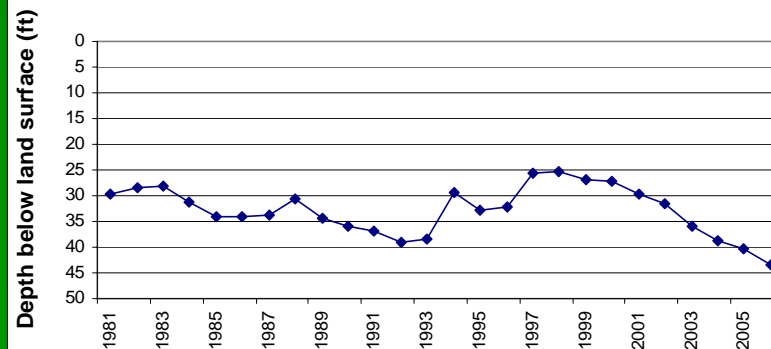
Well PN 17, 21S 17W 31 BDA



Well HG 26, 23S 23W 1 BAA

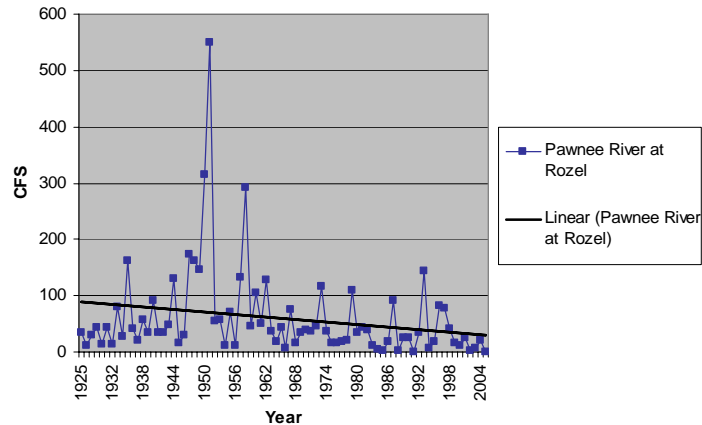


Well HG 3, 22S 22W 13 CCC

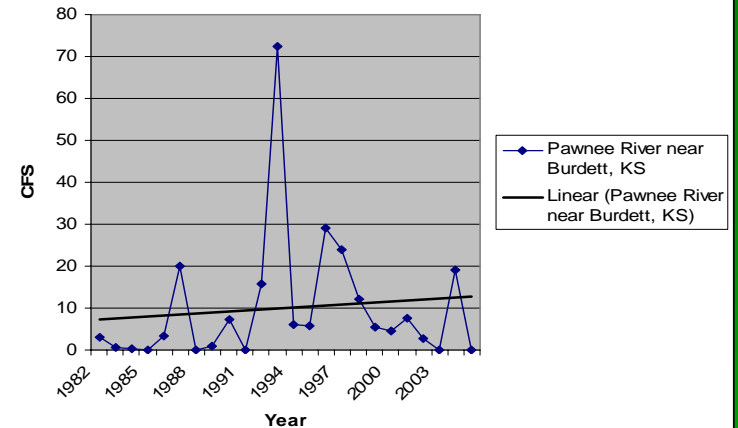


# Surface Water Data Analysis

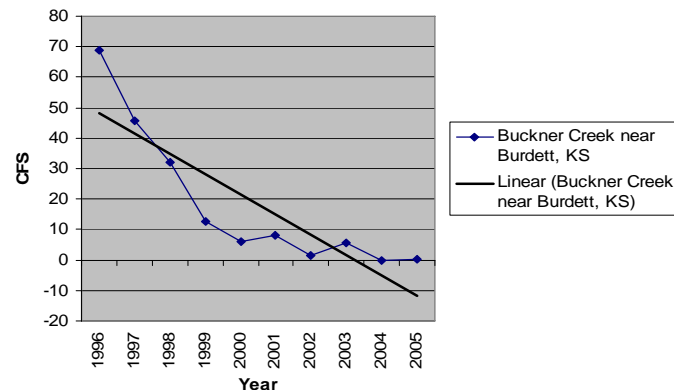
USGS Gaging Station Pawnee River at Rozel, KS



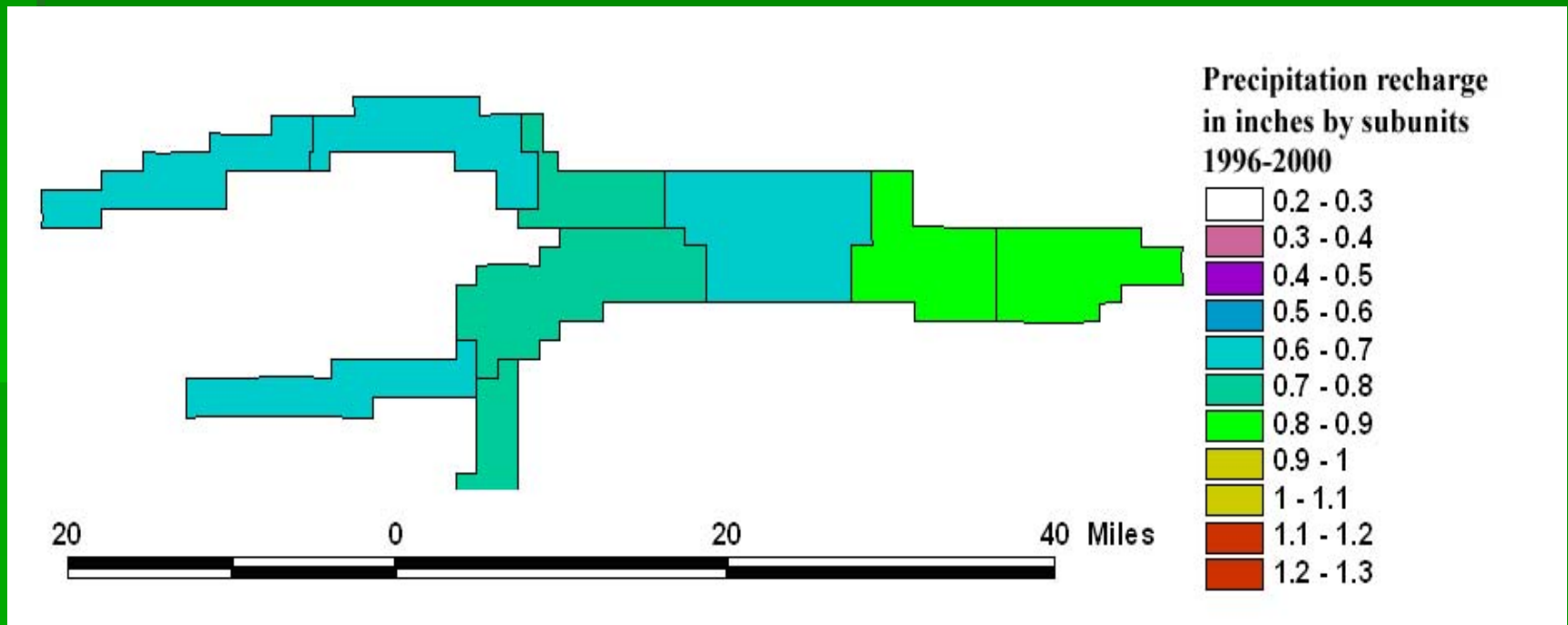
USGS Gaging Station Pawnee River near Burdett, KS



USGS Gaging Station Buckner Creek near Burdett, KS

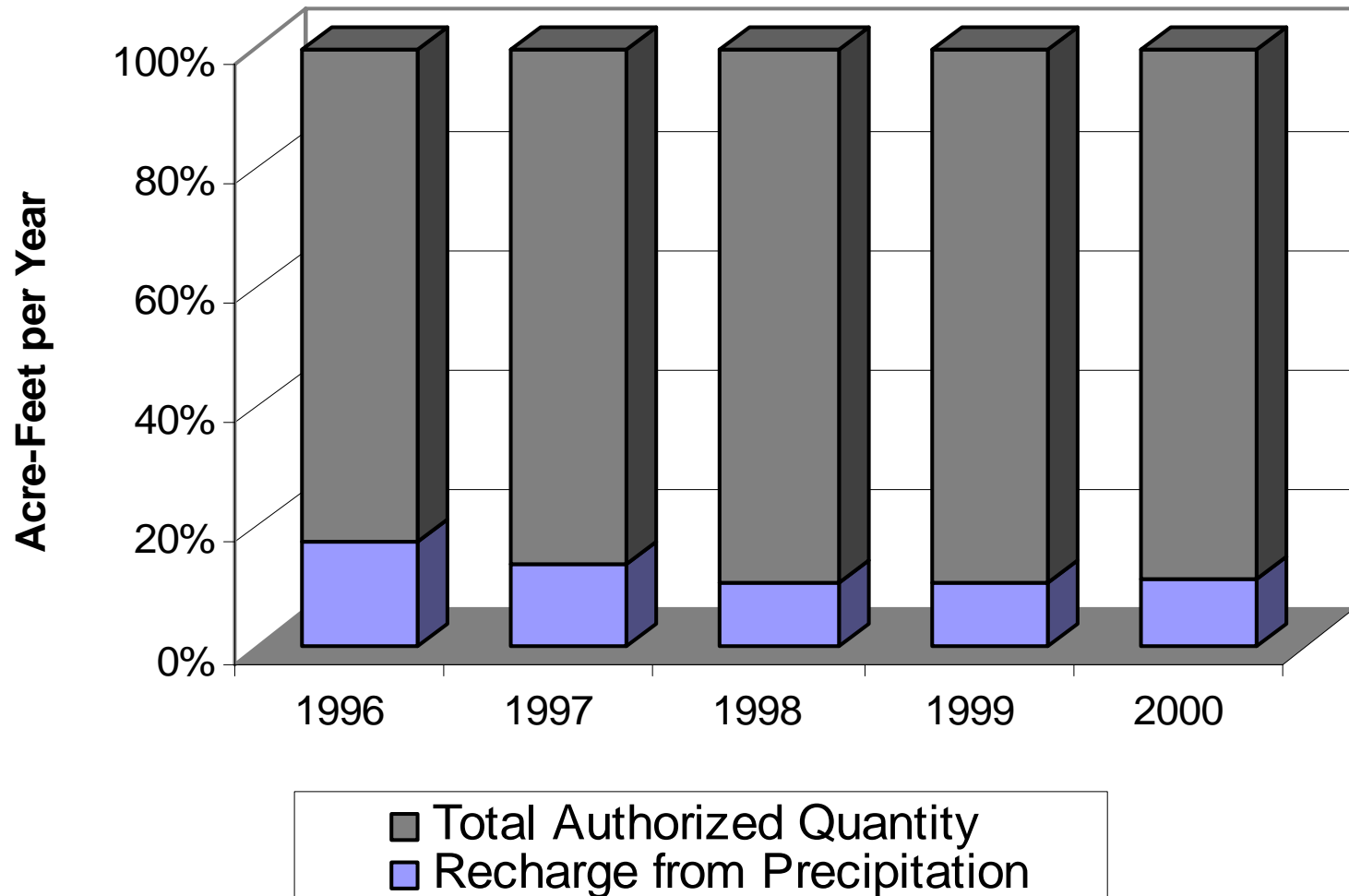


# Estimated Alluvial Recharge Analysis





# Estimated Alluvial Recharge Analysis



# Ground and Surface Water Right Analysis

- KDA-DWR maintains a Water Rights Information System
- 750\* water rights authorized to divert approximately 111,614\* acre-feet per year in the subbasin
- Of this quantity, 98-percent\* is authorized for irrigation water use.
- 57\* surface water rights appropriated for 4,911\* acre-feet. The difference is appropriated for groundwater use (Includes all water use types).

\* All water right values, authorized quantities are estimated

# Ground and Surface Water Use Analysis

Water Right Priority	1996-2000 AVERAGE WATER USE (AF)	2000-2004 AVERAGE WATER USE (AF)	1996-2004 AVERAGE WATER USE (AF)	AUTHORIZED QUANTITY (AF)
Junior	2564	3236	2859	4578
Intermediate	27,270	32,913	29,781	40,590
Senior	9806	12,526	10,972	22,195
Total	39,639	48,674	43,612	67,363

Water use analysis is based on  
approximately 500 non-vested  
irrigation water rights authorized  
at approximately 67,363 acre-feet

# Ground and Surface Water Right Analysis

- Two methods recommended by the committee
  - Hodgeman-Ness recommended a percent reduction from authorized quantity based on priority
  - Pawnee County recommended using a NIR based on priority and to use the highest report acres irrigated 1996-2000

Water Right Classification	Priority Date (determined classification)
Junior	January 1, 1981 to present date
Intermediate	January 2, 1963 – December 31, 1980
Senior	January 1, 1945 – January 1, 1963 excluding vested
Vested	Prior to 1945

# Net Irrigation Requirement Management Approach

- The NIR values to base water use restrictions are based on a reasonable quantity by county to grow crops like corn, sorghum, and soybeans
- Approximately 500 appropriated water rights were analyzed
- The results indicated that after three years of water use reductions NIR based restrictions would not net a water use savings as proposed
- The results also showed that only junior water rights would see a water use reduction in the first year
- In order for the NIR approach to be effective the acre-inch values would need to be lower than proposed.

# Net Irrigation Requirement Management Approach

	Priority for Water Right	County	NIR values by Water right Priority	NIR in acre-inches	Acre-Inches 1996-2000	Acre-Inches 2000-2004
Year one:	Senior	Pawnee	NIR for Corn/.85	14.9	8.28	10.56
	Intermediate	Pawnee	NIR for Corn	12.7	7.8	10.44
	Junior	Pawnee	NIR for Sorghum	10.6	6.7	5.64
Year Two:	Senior	Pawnee	NIR for Corn	12.7	8.28	10.56
	Intermediate	Pawnee	NIR for Sorghum	10.6	7.82	10.44
	Junior	Pawnee	NIR for Sorghum	10.6	6.75	5.64
Year Three:	Senior	Pawnee	NIR for Corn	12.7	8.28	10.56
	Intermediate	Pawnee	NIR for Sorghum	10.6	7.82	10.44
	Junior	Pawnee	NIR for Soybean	9.7	6.75	5.64

# Percent Reduction Management Approach

- Hodgeman-Ness County recommended applying percent reductions to the authorized quantity.
- SWRMP compared reductions to the 1996-2004 average water use.
- The results after three consecutive years of water use reductions the allowable water use would be greater than the 1996-2004 average water use in year one and year two.
- In year three, the water use reductions would net a savings of 10,695 when compared to the 1996-2004 average water use.
- In order to be affective adjustments would need to be made to the percent reductions proposed so that we see a net water use savings in year one and year two (if based on authorized quantity)



# Percent Reduction Management Approach

Year One:	Recent Reduction
Junior Water Rights	50 percent
Intermediate Water Rights	25 percent
Senior Water Rights	10 percent
Vested Rights	No Reduction
Year Two:	
Junior Water Rights	50 percent
Intermediate Water Rights	50 percent
Senior Water Rights	20 percent
Vested Rights	No Reduction
Year Three:	
Junior Water Rights	75 percent
Intermediate Water Rights	60 percent
Senior Water Rights	30 percent
Vested Right	No Reduction

# Drought Level Points

Hydrologic Subunit	1992 average water levels (DBLS-FT)	Average top elevation of water-bearing aquifer thickness (FT)	Average depth to bedrock (FT)	Average water-bearing aquifer thickness (FT)	40 percent water bearing aquifer thickness (DLP-FT)	50 percent water bearing aquifer thickness (DLP-FT)
Pawnee 1	35.99	25.8	55.43	29.63	37.65	40.62
Pawnee 2	50.392	33.97	83.53	49.56	53.79	58.75
Pawnee 3	55.412	48.16	101.73	53.27	69.47	74.80
Pawnee 4	49.104	45.34	103.66	58.32	68.67	74.80
Pawnee 5	43.854	40.53	107.13	66.6	67.17	73.83
Pawnee 6	33.442	33.91	94.76	60.85	58.25	64.34
Buckner 1	31.461	31	61.72	30.72	43.29	46.36
Buckner 2	45.16	37.16	85.38	47.7	56.25	61.01
Sawlog	33.237	32.19	70.5	38.31	47.51	51.35

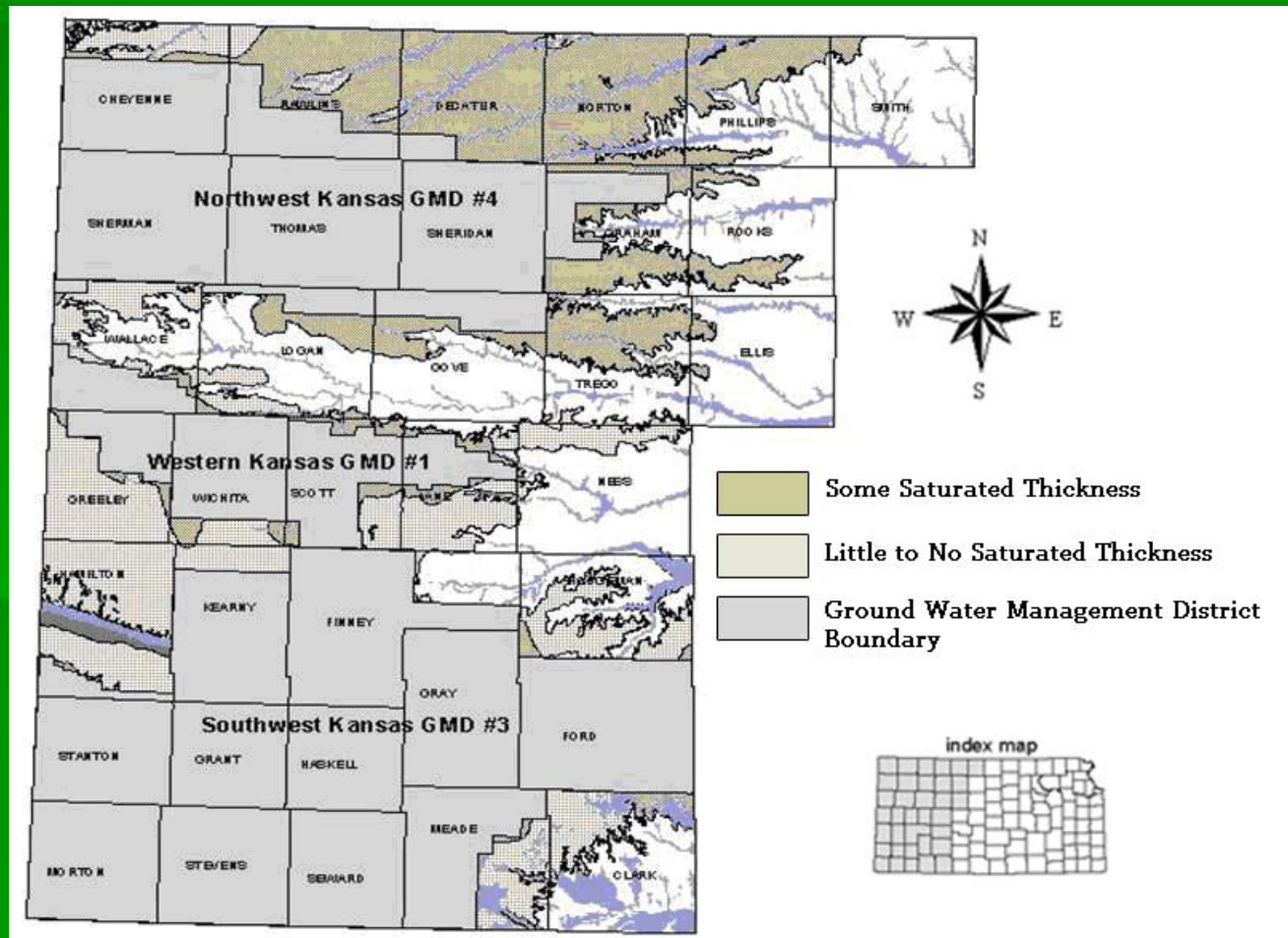
# Recommendations for Management of Alluvial Aquifer

- A DCP is an effective method in mitigating water level fluctuations during drought conditions and provides for a reduction in water use
- The DCP is not designed to address changes in water levels since pre-development
- Data show groundwater declines are occurring upstream of the current Pawnee Valley IGUCA, therefore the extension of the boundaries are appropriate if the chief engineer finds that corrective control provisions are needed to address these declines

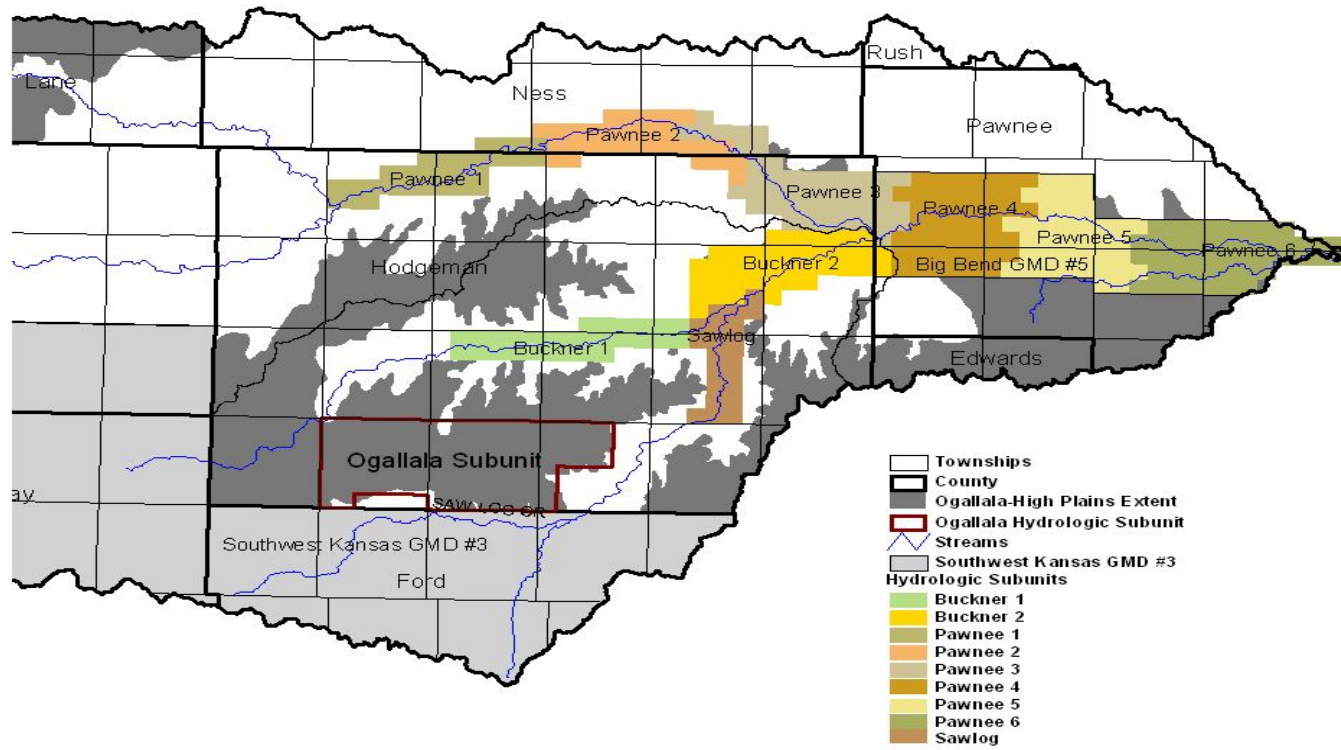
# Recommendations for Management of Alluvial Aquifer

- Establishing a DLP is appropriate, but needs to be set at a point that is no greater than the average 1992 water level
- Both water use reductions proposed could result in a water use savings.
  - The proposed NIR value would need to be adjusted to be an effective management approach.
  - The percent reduction approach proposed would be effective if applied to average water use (1996-2004) or if percentages were adjusted in year one and two to net a water use savings when based on authorized quantities

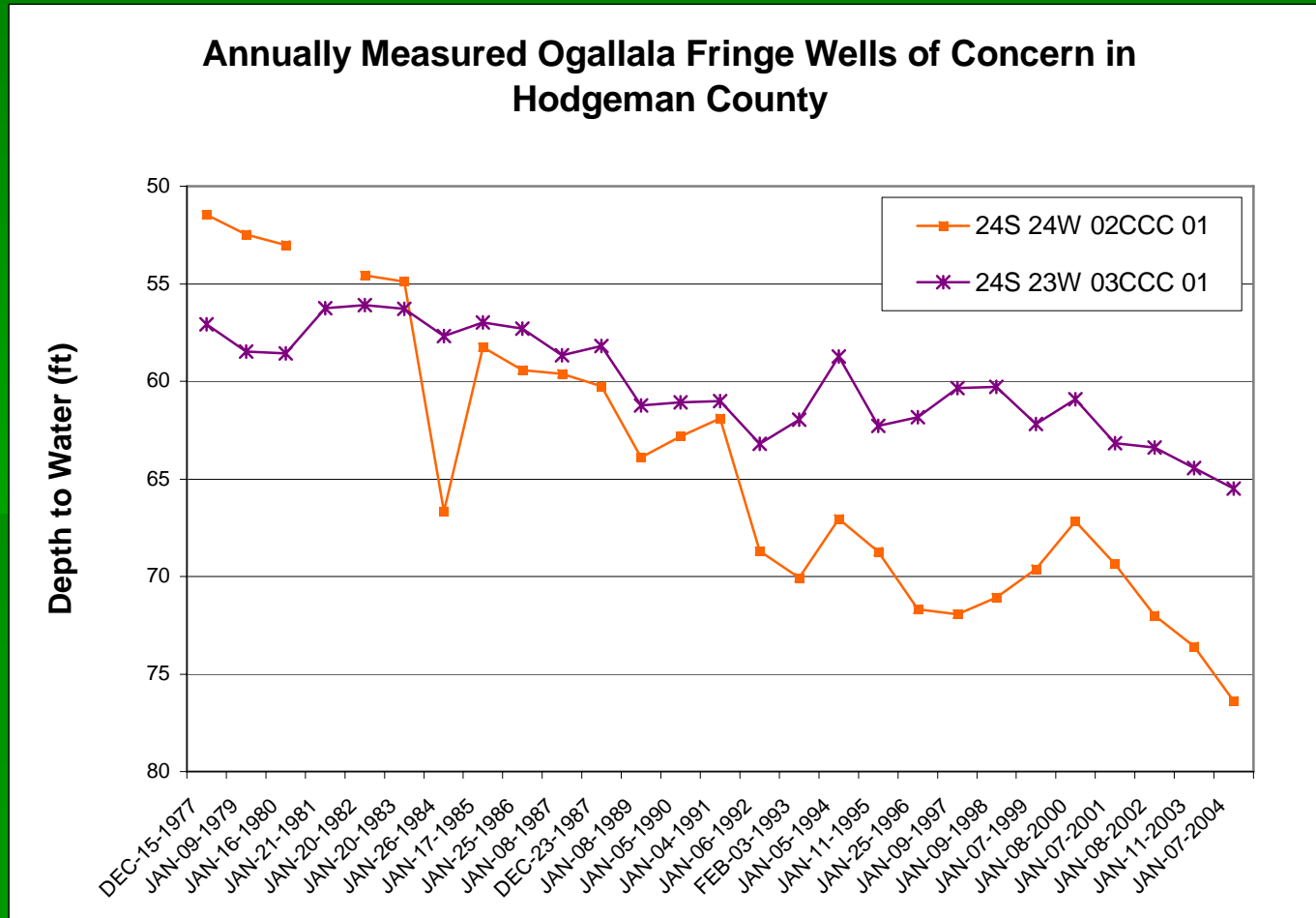
# Ogallala-High Plains Aquifer Analysis



# Ogallala-High Plains Hydrologic Subunit



# Ogallala-High Plains Hydrologic Subunit

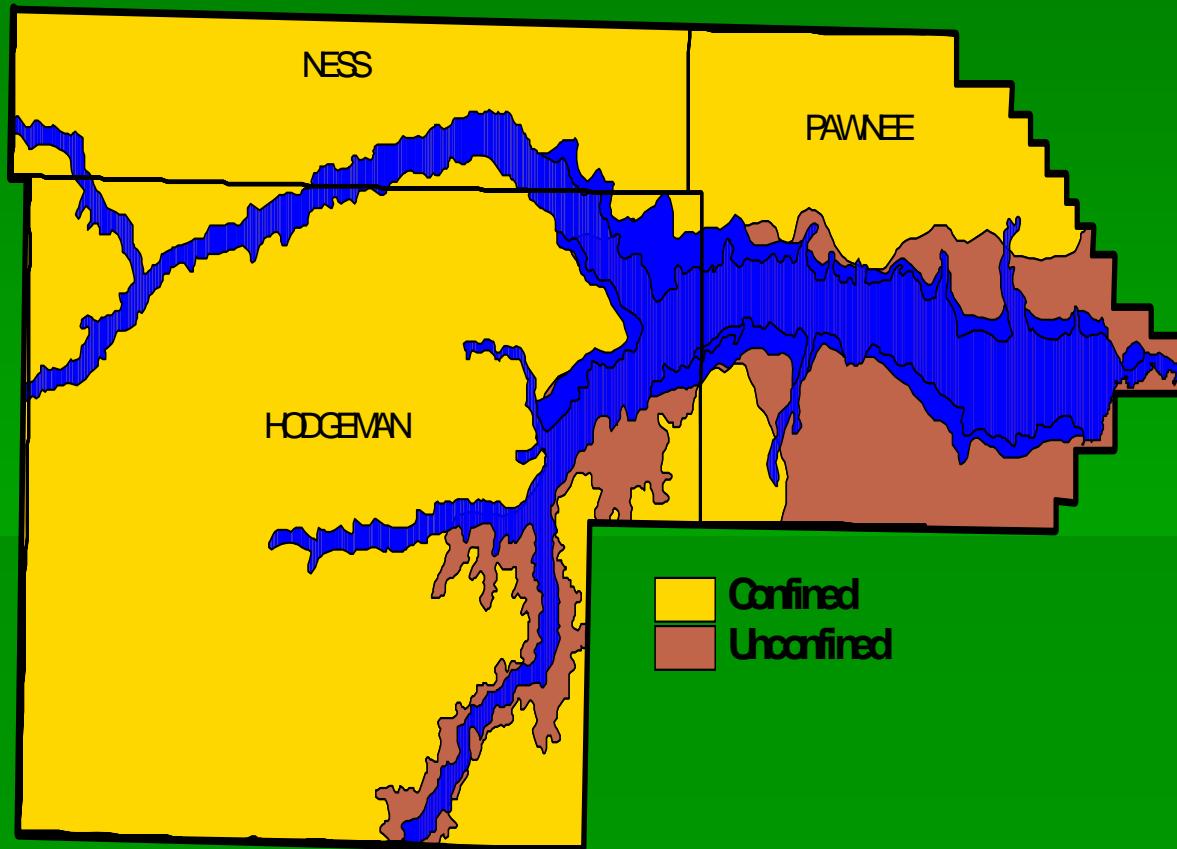




# Recommendations for the Management of Ogallala High Plains Hydrologic Subunit

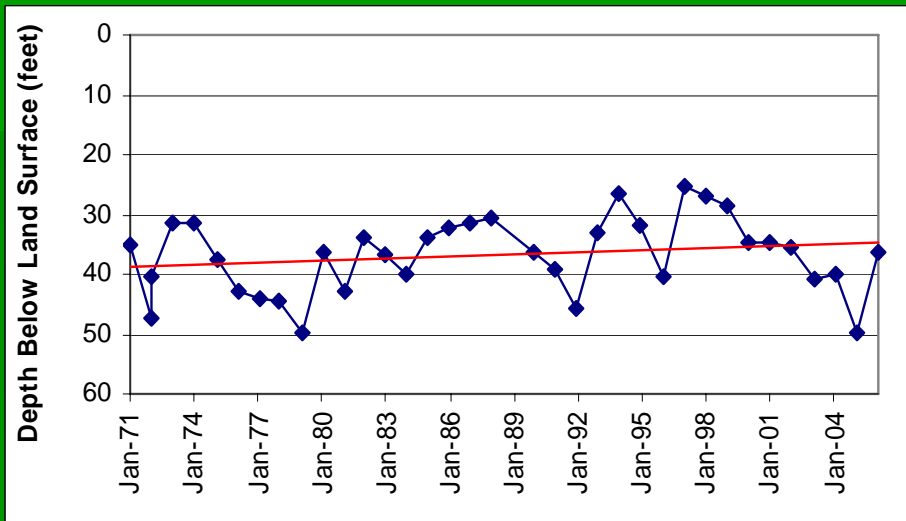
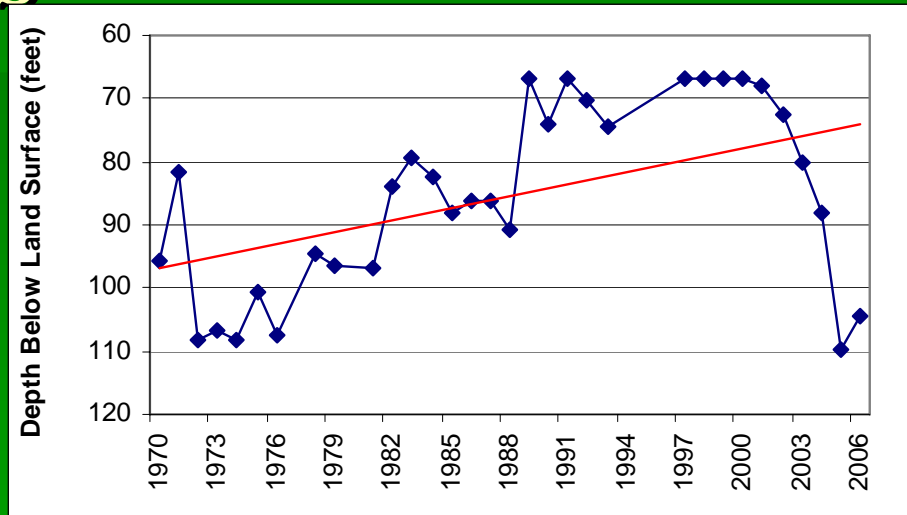
- All vested rights were allocated their current authorized quantities
- All senior rights for irrigation were allocated 10 inches or either the maximum number of acres actually irrigated in any one year from 1996 through 2003 or the maximum authorized acres.
- Junior rights for irrigation were allocated 6 inches on either the max number of acres actually irrigated in any one year from 1996 through 2003.
- Water rights for all other types of beneficial uses were allocated 90% of their maximum use reported to the chief engineer for the period of 1996 through 2003.
- This would be a year round water use reduction and not just during drought conditions.

# Dakota Aquifer Data Analysis



# Dakota Aquifer Groundwater Data Analysis

Well 1: Overall  
Increasing trend 1970-  
2006, but reached an all  
time low in 2005 at 14ft  
below the 1970  
measurement



Well 2: Overall increasing  
trend and reached a low in  
2005 of 15ft below the 1971  
measurement

# Dakota Aquifer Data Analysis

- Water use in the late 1960's to early 1970's was between 7700 to 15,000 AF/Year
- Majority of irrigation water use from the Dakota is in Hodgeman County near Jetmore.
- Most areas would be limited to development due to insufficient water supply and quality of water
- Although, in some areas where it is developed it is in combination with water from the Ogallala-High Plains which provides additional irrigation yields.

# Recommendations for Management in the Dakota Aquifer

- Water uses in the Dakota aquifer influence the Pawnee-Buckner-Sawlog alluvial valley
  - Withdrawals intercept flow that could potentially discharge to the Buckner and Sawlog Creeks
  - Transfer water from the alluvium and unconfined Dakota to the confined Dakota
- Dakota aquifer is locally dependent on recharge from the overlying Ogallala-High Plains and the alluvial aquifer
- Withdrawals from the alluvial aquifer exceed recharge which would replenish the Dakota aquifer
- Water use restrictions are likely not needed in the confined Dakota, but water levels should continue to be monitored.
- Unconfined Dakota aquifer should be managed the same as the alluvial aquifer

# Advisory Committee

- The committee recommended that an advisory committee continue to review annual water level data, climatic changes, water use, and other relevant data to address future needs in the subbasin.
- The advisory committee could make additional recommendations to the chief engineer
- Representative terms and election of advisory committee was outlined by the committee
- In addition, to the recommendations by the committee it would be beneficial to add representative water users from the Ogallala-High Plains aquifer, Dakota aquifer and surface water users to fully address all needs of the area under consideration

# Summary

- Alluvial Aquifer
  - Manage by hydrologic subunit approach
  - Place water use restrictions during drought conditions using adjusted percent reductions on average water use or the adjusted NIR acre-inch
  - Set a DLP at a level no lower than average 1992 water levels
- Ogallala Aquifer
  - Place water use restrictions based on priority within the boundaries of the hydrologic subunit that would be year round and not only during droughts
- Dakota Aquifer
  - Manage same as alluvial valley for the unconfined Dakota aquifer
  - No water use restrictions for the confined Dakota aquifer



# Questions

